

# PAPER REGISTRATION APPARATUS FOR DUPLEX PRINTER

## BACKGROUND OF THE INVENTION

5           This application claims priority from Korean Patent Application No. 2003-2084 filed on 13 January 2003 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

### 1.     Field of the Invention

10           The present invention relates to a duplex printer for printing an image on both sides of a sheet of paper, and more particularly, to a paper registration apparatus for a duplex printer which aligns a leading edge of the print paper parallel to a rotation shaft of a feed roller when the paper is retransferred toward the feed roller for printing a rear surface of the paper after a front surface of the print paper is printed.

### 2.     Description of the Related Art

15           In general, two paper transfer routes for printing on a front surface and printing on a rear surface are provided in a duplex printer having a function of printing both sides of a sheet of paper in addition to a single surface printing function.

20           When an image is to be printed on a single surface of a sheet of paper, one paper sheet on the top of a stack of paper loaded in a paper cassette is picked up by a pickup roller and enters between a feed roller and a multiple transfer prevention roller. The multiple transfer prevention roller prevents multiple sheets of paper from being fed, as will be described in greater detail below. The paper passing through  
25           the feed roller and the multiple transfer prevention roller has a leading edge thereof aligned by a registration roller and is transferred to a development apparatus. An image to be printed on the front surface of the paper is developed by the development apparatus and the developed image of the paper is fused onto the sheet by a fusing apparatus. Then, the sheet of paper is expelled out of the printer  
30           by an exhaust roller.

          In the meantime, when images are to be printed on both sides of the a sheet of paper, an image is printed on the front surface of the sheet and then the paper is retransferred toward the feed roller before the sheet arrives at the exhaust roller. For this purpose, a reversible roller is installed on the paper transfer route prior to the

exhaust roller to reverse a traveling direction of the sheet of paper. Also, a duplex transfer roller is installed between the reversible roller and the feed roller to transfer the sheet of paper toward the feed roller after the traveling direction of the sheet is reversed .

5           FIG. 1 is a perspective view illustrating a portion around a duplex transfer roller and a feed roller in a conventional duplex printer. FIG. 2 is an enlarged perspective view of the duplex transfer roller and an idle roller of FIG. 1. FIG. 3 is a plan view illustrating the duplex transfer roller and the idle roller of FIG. 2 together with a side wall guide.

10           Referring to FIG. 1, a lower guide plate 11 and an upper guide plate (not shown) guide a horizontal surface of a sheet of paper P entering a paper transfer route. A side wall guide 13 is fixedly installed at one side of the guide plates to guide the registration of a side edge of the paper entering between the guide plates. A duplex transfer roller 20 and an idle roller 21 transfer the paper in an inclined  
15 direction toward the side wall guide 13. A guide plate 15 guides the side-aligned paper between a feed roller 16 and a multiple transfer prevention roller 17. A groove 11a accommodating the duplex transfer roller 20 is formed at one side of the lower guide plate 11. A groove corresponding to the groove 11a is formed on the upper guide plate to accommodate the idle roller 21.

20           As shown in FIG. 1, the duplex transfer roller 20 is arranged at one side portion deviated from a center line C of the paper transfer route according to a side feeding method. This arrangement is based on an assumption that double side printing is mainly used for a large size paper such as A4, B4 or A3 size papers which are relatively expensive and in consideration of convenience in installation of the  
25 duplex transfer roller 20 and reduction of costs of parts. This is because installing the duplex transfer roller 20 and the idle roller 21 at the center portion of the paper transfer route would require the rotation shaft 20a of the duplex transfer roller 20 and the rotation shaft 21a of the idle roller 21 to be installed across the entire area of the sheet of paper (see Fig. 2). Also, since the duplex transfer roller 20 and the idle  
30 roller 21 would need to be made lengthy along the rotation shafts 20a and 21a, or two or more duplex transfer roller 20 and idle roller 21 would need to be installed, the cost of parts would disadvantageously increase. Thus, it is difficult to install the duplex transfer roller 20 and the idle roller 21 in a complicated and compact printer.

The alignment operation of the transfer roller is guided, because the side wall guide is formed parallel to the paper transfer route at one side of the paper transfer route.

Referring to FIGS. 2 and 3, the duplex transfer roller 20 is installed perpendicular to a direction of the paper transfer route, that is, to the side wall guide 13 while the idle roller 21 installed above the duplex transfer roller 20 is fixed such that the rotation shaft 21a of the idle roller 21 is inclined at an angle of about  $6^\circ$  with respect to the rotation shaft 20a of the duplex transfer roller 20. The rotation shaft 21a of the idle roller 21 is rotatably installed in an idle roller rotation shaft holder 24. Both sides of the idle roller rotation shaft holder 24 are elastically supported by a torsion spring 23 in a downward direction.

The idle roller 21 installed inclined with respect to the side wall guide 13 transfers the print paper in a direction inclined to the paper transfer route to transfer the leading edge of the sheet of paper toward the side wall guide 13. The print paper contacting the side wall guide 13 proceeds in a direction of the paper transfer route along the side wall guide 13 so that the side edge of the print paper is aligned by the side wall guide 13 and then the paper is transferred between the feed roller 16 and the multiple transfer prevention roller 17 along a curved surface of the guide plate 15.

The weight of the print paper used for a duplex printer can vary within a range of about  $60\text{--}100\text{ g/m}^2$ . In a conventional duplex printer, the rotation shaft 21a of the idle roller 21 transferring the print paper toward the side wall guide 13 is intentionally installed inclined. When the angle of inclination of idle roller 21 is fixed, if the width or weight of the print paper changes, a paper side registration function is deteriorated. For example, when the fixed inclination angle is great, paper needing a relatively small force to move, such as a Letter size paper having a weight of around  $60\text{ g/m}^2$ , is excessively moved so that the side edge of the paper may be damaged due to friction with the side wall guide 13. In contrast, when the inclination angle is small, paper needing a relatively great force to move, such as an A4 size paper having a weight of around  $100\text{ g/m}^2$  does not contact the side wall guide 13 so that the side registration may not be accomplished. Furthermore, setting the inclination angle to an intermediary value limits the type of paper that can be used.

When a sheet of paper whose side edge is not aligned passes through the feed roller 16 and enters the registration roller, since the registration roller aligns the

leading edge of the print paper, printing is performed in a state in which the print paper is not aligned in a lateral direction. Thus, an image is cut off at a side edge of the print paper or an image printed on the rear surface is deviated from the image printed on the front surface so that print quality is lowered.

5 Japanese Patent Publication No. H6-278914, the entire contents of which is incorporated by reference herein, discloses a technology to prevent mis-registration generated by the above-described fixed type idle roller. In the document, an idle roller holder is elastically connected by a torsion spring and the direction of an idle roller rotation shaft is moved in a direction perpendicular to the side wall guide by a  
10 frictional force which is generated when paper is moved in contact with a side wall guide in a traveling direction. However, since the idle roller rotation shaft is separated a predetermined distance from a pivot center point of the idle roller holder, during the rotation of the idle roller rotation shaft, the center point of the idle roller is deviated from the center point of a duplex transfer roller so that a feeding force of the  
15 duplex transfer roller is lowered. Thus, when the rear surface of the paper is printed, a paper jam may be caused by resistance of the upper and lower guide plates as the paper passes between the upper and lower guide plates.

#### SUMMARY OF THE INVENTION

20 To solve the above and/or other problems, the present invention provides a paper registration apparatus for a duplex printer which efficiently aligns the side edge of the print paper by variably setting the inclination angle of the transfer roller according to the type of paper transferred during the paper rear surface printing procedure of the duplex printer.

25 Accordingly, an embodiment of the present invention provides a paper registration apparatus for a duplex printer which performs side registration of a sheet of paper before the paper is transferred toward a feed roller to print an image on a rear side of the paper after a front side of the paper is printed. The apparatus comprises a lower guide plate supporting the sheet of paper thereon and having a  
30 groove formed at one side; a side wall guide vertically installed at the side of the groove of the lower guide plate parallel to a direction of a paper transfer route to perform a side registration of the paper; and a duplex transfer roller installed perpendicular to the direction of the paper transfer route. The apparatus further comprises an idle roller installed above the duplex transfer roller at a predetermined

inclination angle with respect to the duplex transfer roller; an idle roller rotation shaft holder rotatably supporting both ends of a rotation shaft of the idle roller; a pressing unit providing an elastic force to the idle roller toward the duplex transfer roller; and a pivot unit setting the inclination angle of the idle roller within a predetermined range according to the type of paper. An upper guide plate having a groove formed at a position corresponding to the groove of the lower guide plate is provided above the lower guide plate. A range of the inclination angle is substantially between 4°-9°, and preferably between 5°-8°.

The pivot unit comprises an elastic member elastically supporting one side of the idle roller rotation shaft holder; an arm extending horizontally from the idle roller rotation shaft holder in a direction perpendicular to the idle roller rotation shaft; and a confining unit confining a pivot range of the arm. The confining unit includes a stopper where a slot is formed to confine a horizontal space in which the arm is inserted and pivots.

The pressing unit comprises a circular column member extending upward from an upper center portion of the idle roller rotation shaft to be rotatably supported in a printer body; and a coil spring installed around an outer circumference of the circular column member to press the idle roller rotation shaft holder and the idle roller toward the transfer roller, wherein the circular column member is a center shaft of the rotation of the idle roller.

#### BRIEF DESCRIPTION OF THE DRAWINGS

The above and other features and advantages of the present invention will become more apparent with reference to the accompanying detailed description of the preferred embodiments and with reference to the attached drawing figures in which:

FIG. 1 is a perspective view illustrating a portion around a duplex transfer roller and a feed roller in a duplex printer;

FIG. 2 is an enlarged perspective view illustrating the duplex transfer roller and an idle roller of FIG. 1;

FIG. 3 is a plan view illustrating the duplex transfer roller and the idle roller of FIG. 2 together with a side wall guide;

FIG. 4 is a side view illustrating the duplex printer having two paper transfer routes for the print of the front and rear surfaces of the print paper according to an embodiment of the present invention;

FIG. 5 is a perspective view illustrating a paper registration apparatus according to an embodiment of the present invention;

FIG. 6 is a plan view illustrating the paper registration apparatus of FIG. 5; and

FIG. 7 is a view for explaining the operation of a stopper and an arm of FIG. 5.

#### DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 4, a paper cassette 110 for accommodating a stack of papers is detachably installed in a main body of a duplex printer 100. A pickup roller 120 having a half moon shape is rotatably installed in a main body of the printer so as to contact a leading edge portion of a sheet of paper P at the top of the stack of papers accommodated in the paper cassette 110. Thus, when the pickup roller 120 rotates, the sheet of paper P at the top of the stack is picked up by a frictional force of the pickup roller 120 and enters between a feed roller 130 and a multiple transfer prevention roller 135. The multiple transfer prevention roller 135 rotates in contact with the feed roller 130. When two or more sheets of paper are picked up by the pickup roller 120, the multiple transfer prevention roller 135 transfers only the top sheet of paper P at the top of the stack of paper and prevents the other sheets from being transferred.

The operation of the multiple transfer prevention roller 135 will now be described in greater detail. The multiple transfer prevention roller 135 rotates at a torque less than that of the feed roller 130 in the opposite direction to a rotation direction of the feed roller 130. However, since the multiple transfer prevention roller 135 contacts the feed roller 130, when there is no paper or only one sheet of paper between the multiple transfer prevention roller 135 and the feed roller 130, the multiple transfer prevention roller 135 is rotated by the feed roller 130 having a torque greater than the multiple transfer prevention roller 135 in a direction in which the print paper proceeds. However, when two or more sheets of paper enter between the multiple transfer prevention roller 135 and the feed roller 130, the multiple transfer prevention roller 135 can rotate in the opposite direction to the direction in which the paper proceeds since the multiple transfer prevention roller

135 is not influenced by a rotational force of the feed roller 130 due to a low frictional force between the rollers 130 and 135. Accordingly, any sheets of paper other than the sheet at the top of the stack of paper which contacts the feed roller 130 are prevented by the multiple transfer prevention roller 135 from proceeding in the direction in which the paper P proceeds.

The leading edge portion of the sheet of paper P passing through the feed roller 130 and the multiple prevention roller 135 is aligned by a registration roller 140. Then, the paper P having its leading edge portion aligned by the registration roller 140 enters the development apparatus 150 where a photoreceptive drum 151 and a transfer roller 152 are provided. The development apparatus 150 coats a surface of the photoreceptive drum 151 where an electrostatic latent image is formed, with a developing agent, to develop the electrostatic latent image. The developed image is transferred to the sheet of paper by the transfer roller 152. The image transferred to the paper is heated and pressed by a fusing apparatus 160 so that the image is fused on the paper. As the paper passes the fusing apparatus 160, it is guided by the guide roller 165 and transferred toward an exhaust roller 170.

When an image is printed only on the front surface of the paper, the sheet passes through the fusing apparatus 160 along a first paper transfer route D1 and is exhausted out of the printer by the exhaust roller 170. A reversible roller 180 installed prior to the exhaust roller 170 rotates in a direction in which the print paper is exhausted so as not to prevent the exhaust of the printed sheet of paper. However, the rotation direction of the reversible roller 180 changes when both sides of the sheet of paper are to be printed.

When images are printed on both sides of the sheet of paper, an image is first printed on the front surface of the paper as described above. To print an image on the rear side of the paper, the direction of the paper passing through the fusing apparatus 160 is changed by the reversible roller 180 rotating in the opposite direction to the direction in which the paper is exhausted. Accordingly, the paper is transferred back toward the feed roller 130 and the multiple transfer prevention roller 135 along a second paper transfer route D2. The sheet of paper enters between upper guide plate 181 and lower guide plate 182 which guide a horizontal surface of the second paper transfer route D2 and then between a duplex transfer roller 190 and an idle roller 191. The sheet of paper entering between the duplex transfer roller 190 and the idle roller 191 is side-aligned by the duplex transfer roller 190 and the

idle roller 191 with respect to a side wall guide 198 of FIG. 6. The side-aligned paper is guided by a guide plate 183 and supplied to the feed roller 130.

The leading edge of the paper passing between the feed roller 130 and the multiple transfer prevention roller 135 is realigned by the registration roller 140. The registration of the paper by the registration roller 140 registers the leading edge of the sheet of paper whereas side-registration is accomplished by the duplex transfer roller 190 and the idle roller 191, in combination with side wall guide 198.

Referring to FIGS. 5 and 6, the side wall guide 198 is installed at one side of the upper and lower guide plates 181 and 182, parallel to the direction of the paper transfer route, to guide the side registration of the sheet of paper. A groove (refer to the groove 11a of FIG. 1) for accommodating the duplex transfer roller 190 and the idle roller 191 is formed at one side of the upper and lower guide plates 181 and 182. The duplex transfer roller 190 is installed perpendicular to the direction of the side wall guide 198, and hence the paper transfer route.. The idle roller 191 installed above the duplex transfer roller 190 is installed in an idle roller rotation shaft holder 192 such that both ends of a rotation shaft 191a can rotate. A circular column member 193 extends upward from a portion corresponding to the center of the idle roller 191 on the idle roller rotation shaft holder 192. One end of the circular column member 193 is rotatably fixed in the printer body.

An arm 196 is formed on the idle roller holder 192 to extend in a direction perpendicular to the idle roller rotation shaft 191a. The pivot range of the arm 196 is confined by a stopper 197 having a slot 197a horizontally formed therein. The stopper 197 is fixedly installed in the printer body. Thus, the idle roller holder 192, the idle roller shaft 191a, and the idle roller 191 can pivot around the circular column member 193 within the space of slot 197a of the stopper 197. That is, as shown in FIG. 7, the arm 196 is restrictively moved in the slot 197a of the stopper 197 with respect to a center shaft of the circular column member 193 so as to confine an inclination angle of the idle roller 191. In one embodiment, the slot 197a is formed so that the idle roller 191 has an inclination angle of at or about 5° to at or about 8° with respect to the duplex transfer roller 190, but can have any suitable angle.

A coil spring 194 having one end connected to an upper surface of the idle roller holder 192 and the other end fixed on the printer body is provided around the outer circumference of the circular column member 193 to provide a predetermined



elastic force to the idle roller 191 toward the transfer roller 190. Another coil spring 195 extending toward the side wall guide 198 is provided at one side of the idle roller holder 192 to be elastically biased in the printer body.

The operation of the paper registration apparatus having the above structure according to an embodiment of the present invention will now be described with reference to the attached drawings. The idle roller 191 is passively engaged with the duplex transfer roller 190 by an elastic force of the coil spring 194 inserted around the circular column member 193 and elastically biased by the coil spring 195 which elastically biases the idle roller holder 192 at an angle of at or about  $8^{\circ}$  inclined with respect to a direction perpendicular to the side wall guide 198. According to experiments, when a Letter size paper ( $60 \text{ g/m}^2$ ) is to be used, the side registration is smoothly performed when the inclination angle of the idle roller 191 is at or about  $5^{\circ}$ . When an A4 size paper ( $100 \text{ g/m}^2$ ) is to be used, an appropriate inclination angle of the idle roller 191 is at or about  $8^{\circ}$ .

First, a case of performing the side registration with respect to a Letter size paper having a weight of around  $60 \text{ g/m}^2$  will be described. The sheet of letter sized paper passing between the upper guide plate 181 and the lower guide plate 182 for printing on the rear side of the sheet of paper enters between the duplex transfer roller 190 and the idle roller 191. The paper is transferred toward the side wall guide 198 by the idle roller 191 set to be inclined at an angle of  $8^{\circ}$  with respect to a direction perpendicular to the direction of the paper transfer route. Then, the leading edge of the sheet of paper contacts the side wall guide 198 and proceeds further along the side wall guide 198 so that side registration is accomplished. Since the paper in use is relatively light, a predetermined repulsive force is generated from the side wall guide 198 as the paper collides against the side wall guide 198. The repulsive force is transferred to the idle roller holder 192 supporting the idle roller 191 to push the idle roller 191 which is elastically biased, around a center shaft of the circular column member 193, in a direction separated from the side wall guide 198. The repulsive force varies according to the type of paper. For the Letter size paper ( $60 \text{ g/m}^2$ ), the repulsive force is applied until the inclination angle of the idle roller 191 is at or about  $5^{\circ}$ . The arm 196 is moved toward one end of the slot 197a formed in the stopper 197, that is, in the opposite direction to the direction A. Since the repulsive force is removed when the print paper escapes from the idle roller 191,

the idle roller 191 returns to the original position (the position indicated by a solid line of FIG. 7) by a restoration force of the coil spring 195.

When an A4 size sheet of paper having a weight of around  $100 \text{ g/m}^2$  is to be printed, the paper passes between the upper guide plate 181 and the lower guide plate 182 and enters the duplex transfer roller 190 and the idle roller 191. The paper is moved toward the side wall guide 198 by the idle roller 191 which is set to be inclined at an angle of  $8^\circ$  with respect to a direction perpendicular to the direction of the paper transfer route. The leading edge of the sheet of paper contacts the side wall guide 198 and proceeds further along the side wall guide 198 so that side registration is accomplished. Since the paper in use is relatively heavy, when the paper contacts the side wall guide 198, a repulsive force is not generated from the side wall guide 198. Thus, the side registration of the sheet of paper is performed with the inclination angle of the idle roller 191 remaining at or about  $8^\circ$ . The side-aligned paper escapes from the upper and lower guide plates 181 and 182 and is transferred toward the feed roller 130 along a curved surface of the guide plates 183.

As described above, in the paper registration apparatus for a duplex printer according to an embodiment of the present invention, when the paper is retransferred to print an image on a rear side of the print paper, since the repulsive force transferred from the side wall guide makes the idle roller inclined at an appropriate angle for side registration of the particular type of paper in use, side registration is smoothly performed. Thus, printing is performed accurately on the sheet of paper.

While this invention has been particularly shown and described with reference to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention as defined by the appended claims and equivalents thereof.